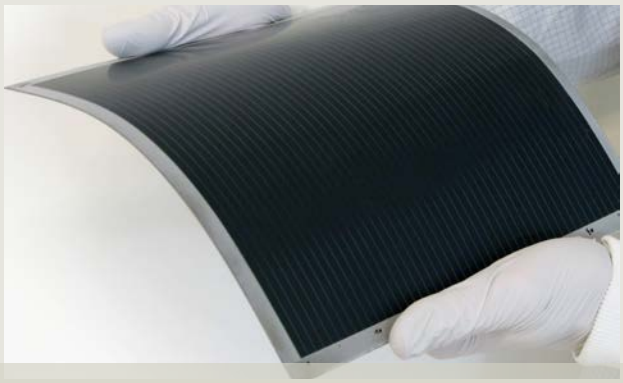
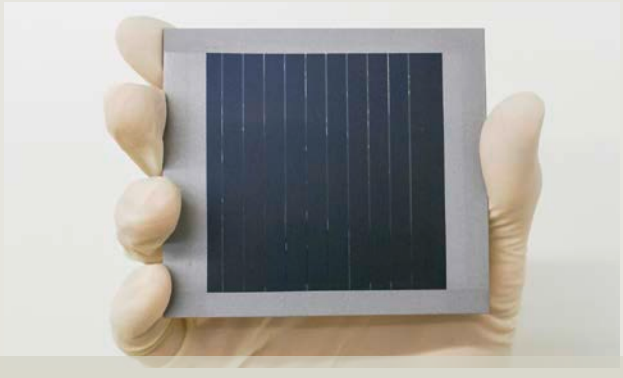
// ZSW PV Materials Research: Non-Glass Substrates
CIGS-based solar cells on cost-effective substrates



// Flexible solar module on enamelled steel substrate

// Thin polyimide film used in ZSW web coater at low temperatures



// Monolithically integrated mini-module on insulated, cost-effective steel substrate with an efficiency of 8.6 %

Research & development of novel substrates:

// Mild steel foils with various anti-corrosion coatings for roll-to-roll processing (together with external partner)
// Enamelled metallic substrates (sheets and foils) for CIGS high-temperature deposition, including absorber doping via the enamel layer
→ Status: > 18 % cell efficiency
// Investigation of various thin polyimide films for CIGS low-temperature processing

Buffer layers:

// Inline and vacuum-deposited Cd-free buffers
→ Status: > 18 % cell efficiency on glass substrates

Monolithic cell interconnection on non-glass substrates:

// Development of dielectric barrier layers for metal substrates; goal: fabrication of monolithically integrated modules on cost-effective metallic substrates such as low-carbon steel
→ Status: 8.6 % mini-module efficiency
// Patterning of back contact, absorber and window layers via mechanic tool, nano- or picosecond laser
→ Status: 10 % mini-module efficiency on polyimide film; > 15 % efficiency on enamelled steel

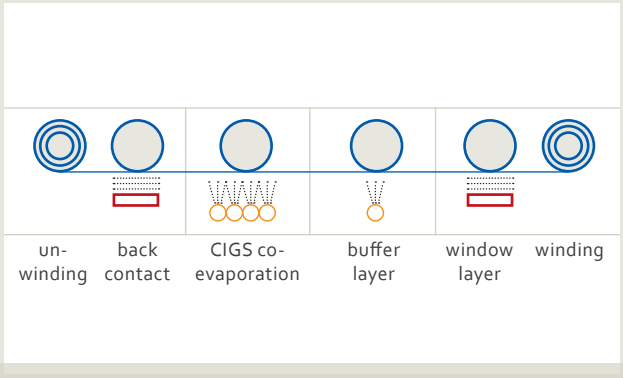
Flexible encapsulation:

// Investigation / development and testing of cost-effective, optically transparent barrier layers against water and oxygen transmission

Contact
Claudia Brusdeylins
+49 (0)711 7870-278
claudia.brusdeylins@zsw-bw.de

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg
Certified according to DIN EN ISO 9001:2008
www.zsw-bw.de

// ZSW PV Materials Research: Non-Glass Substrates
Roll-to-roll deposition of CIGS solar cells



// Schematic view of the R2R web coater at ZSW

// The R2R web coater for CIGS deposition at ZSW

// Winding unit of the R2R web coater at ZSW

Characteristics:

Integrated (all-in-one) vacuum-based R2R-reactor, including back contact, absorber, buffer and window layer deposition: same vacuum, only one unwinding- and winding unit

Features:

// Reactor length: 12m
// sputtering on the roll
// CIGS coevaporation via free span and bottom-up
// horizontal tape run, coating in both web transport directions possible
// deposition both onto metal and plastic webs
// current operation: polyimide web, thickness: 25 µm – 50 µm, web width: 30 cm

Developments in progress:

// cadmium-free vacuum buffer
// multistage CIGS evaporation for enhancing efficiency
// investigation of various sodium deposition methods

Status:

→ 13.5 % cell efficiency (single stage CIGS, without anti-reflection coating)

Contact
Claudia Brusdeylins
+49 (0)711 7870-278
claudia.brusdeylins@zsw-bw.de

2014-08

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg
Certified according to DIN EN ISO 9001:2008
www.zsw-bw.de